Stratigraphic and Structural Architecture along the Malartic Transect in the Southern Abitibi and Pontiac Subprovince

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METAL EARTH

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Laurentian University Université Laurentienne

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APOGÉE CANADA FONDS D'EXCELLENCE EN RECHERCHE

Outline

- **Project Overview**

  Transect location, General Geology, Regional Faults, Mineral Occurrences, Major Research Topics

- **Transect Mapping**

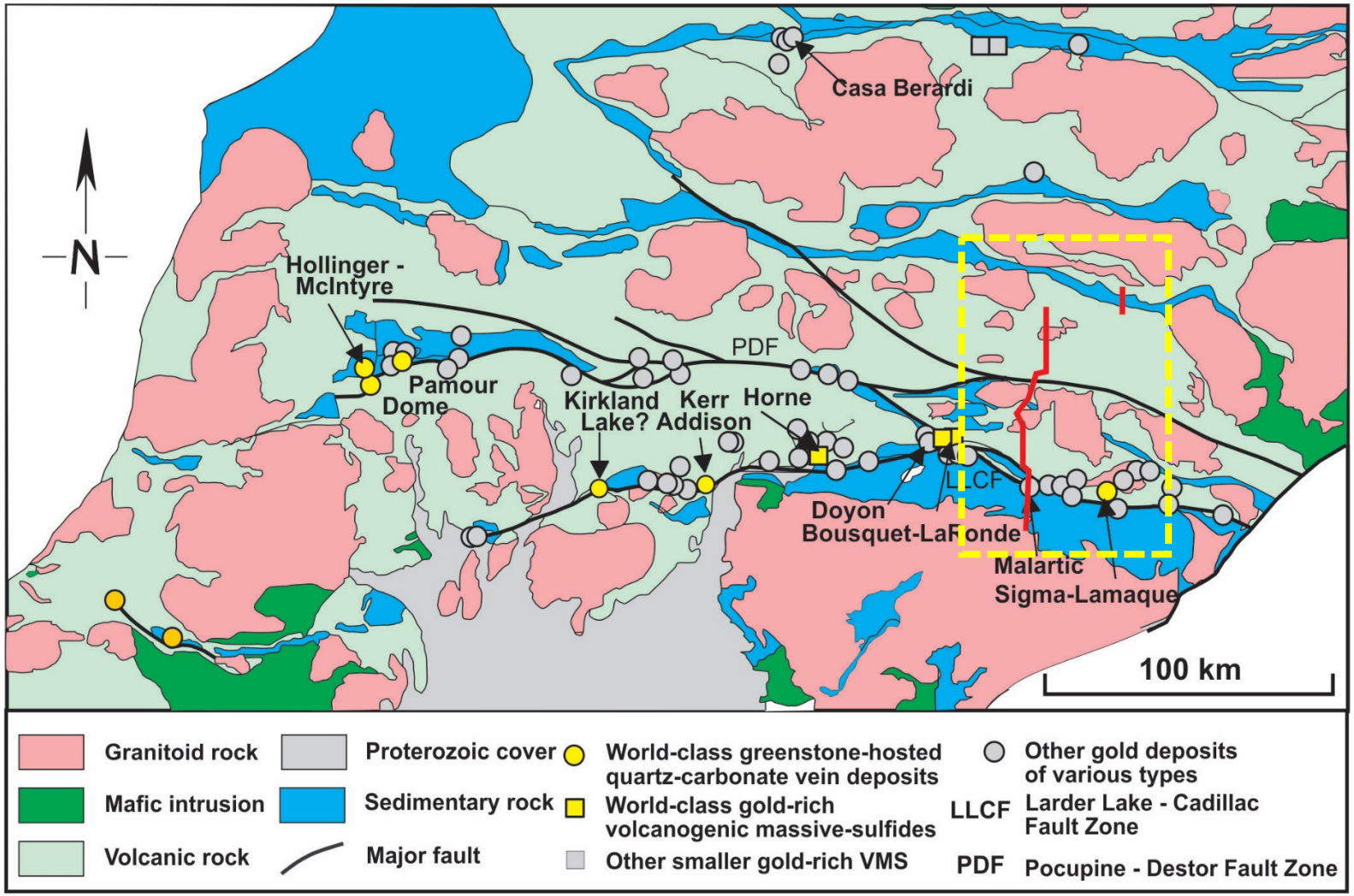
  Targeted Geological Mapping, Aeromagnetic Data and Seismic Data

- **Research/Thesis Topics**

  Contact relationships between volcanic terranes and sedimentary basins;

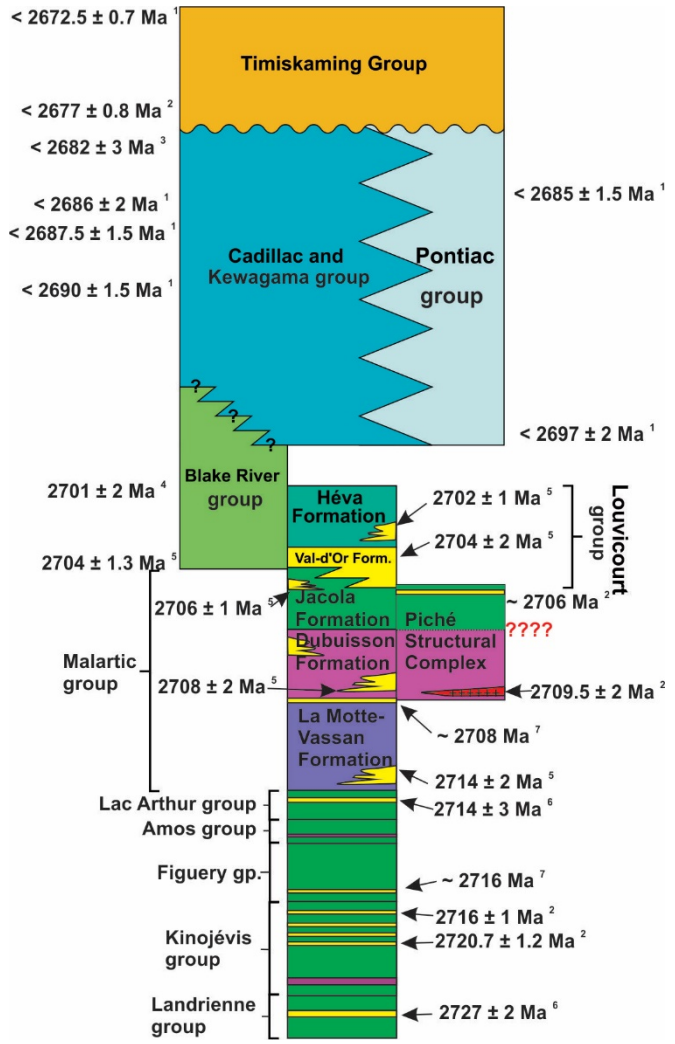
  Deposit- and District-scale research on mineral deposits in crustal scale deformation zones

Southern Superior Province

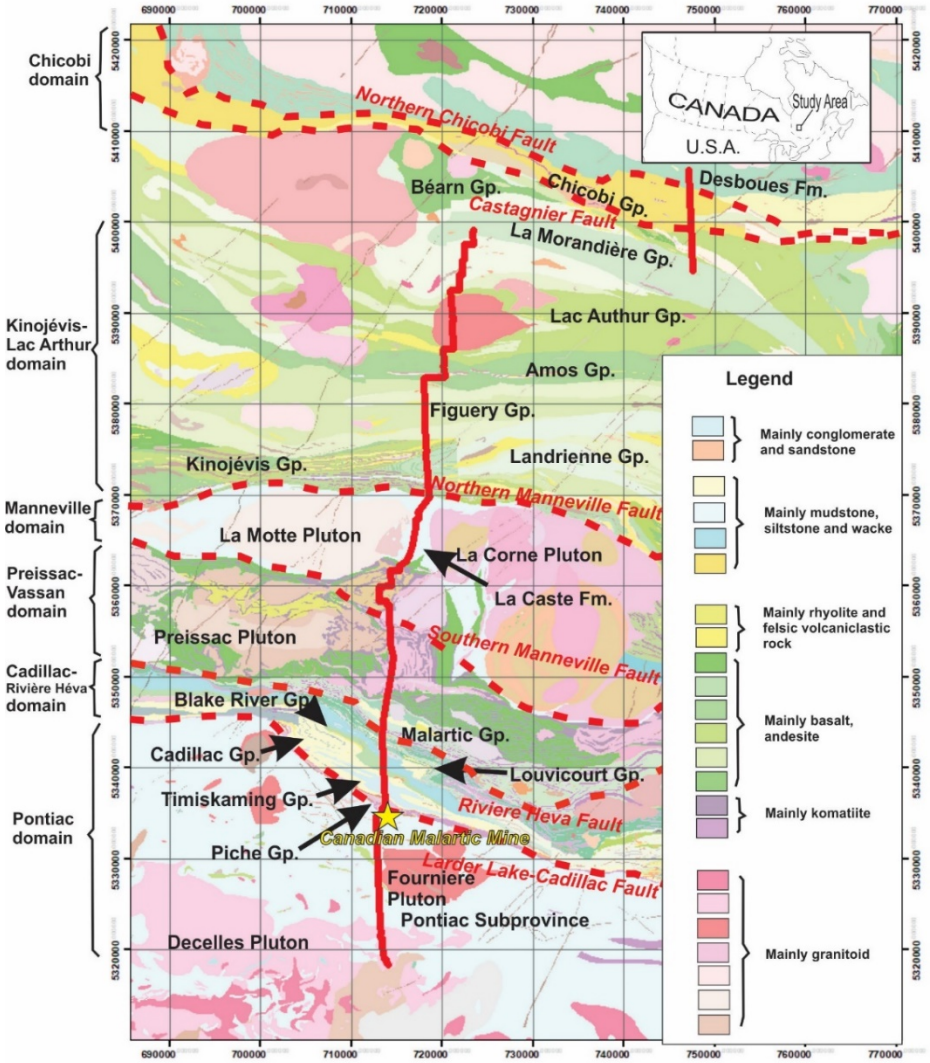


Dubé and Gosselin, 2007

Malartic Transect: Stratigraphy



Modified from Pilote et al. 2015 and Bedeaux et al., 2017



Modified from SIGEOM, 2017

Deformation and Metamorphism

D1: isolated S1 fabrics in the clasts of Timiskaming type conglomerate or xenoliths in plutonic rocks

D2: N-S Shortening; penetrative NW-N S2 cleavage, moderate to steep L2 lineation, isoclinal upright F2 folds

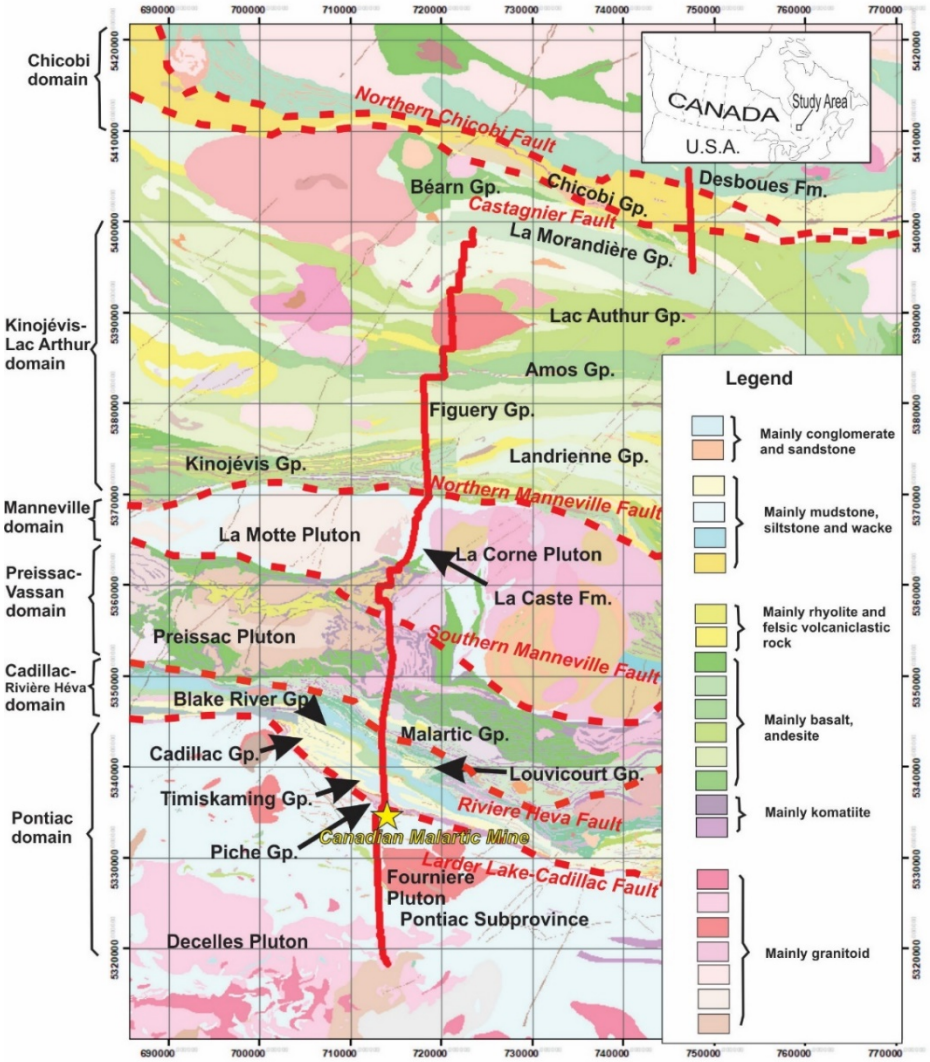
D3: Sinistral shearing

En echelon vein arrays

D4: Dextral shearing

Z drag folds and shear band cleavage, cleavage anticlockwise to S2, shallow lineation

M: late- or post-D2 Greenschist to Amphibolite facies, Peak at ca. 2657±7 Ma (Piette-Lauziere, 2017)



Modified from SIGEOM, 2017

Mineralization

Nickel Mineralization

- Marbridge, Cubric
- Malartic Group
- Southern Manneville Fault

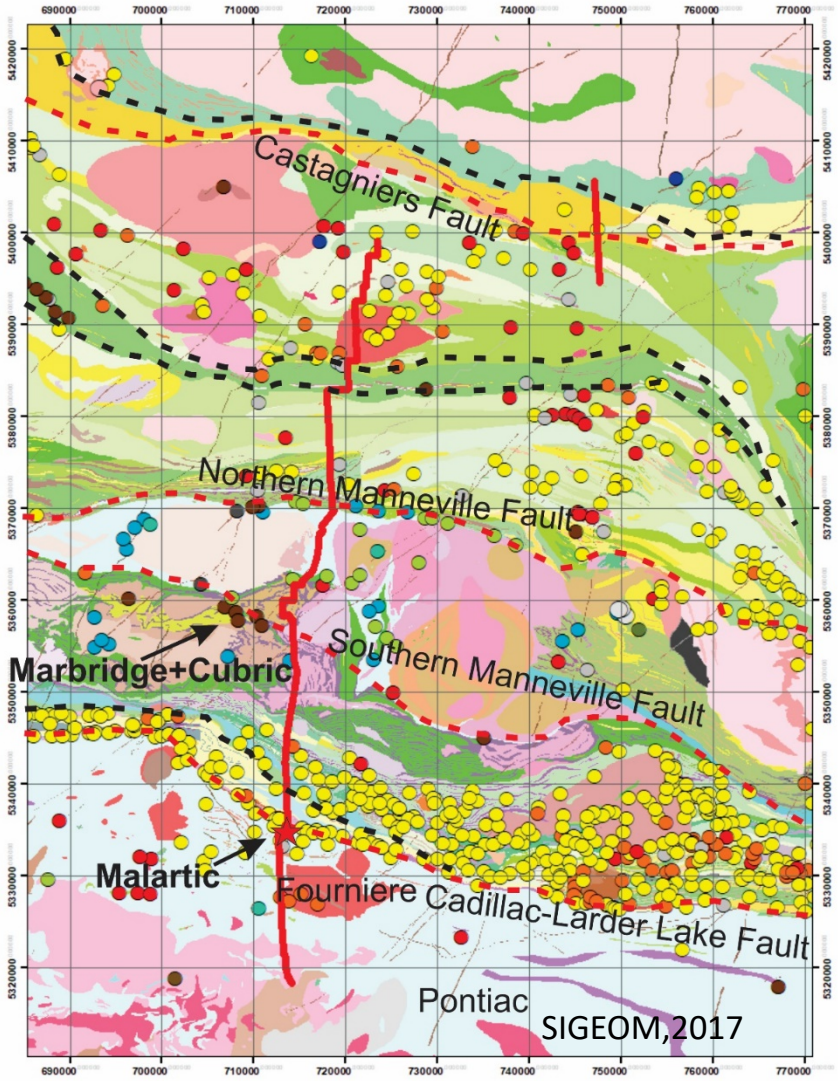
Gold Mineralization

- Vein-type dominated
- Various host rocks
- Structural control

  Castagnier Fault

  Porcupine-Destor-Manneville Fault

  Larder Lake-Cadillac Break

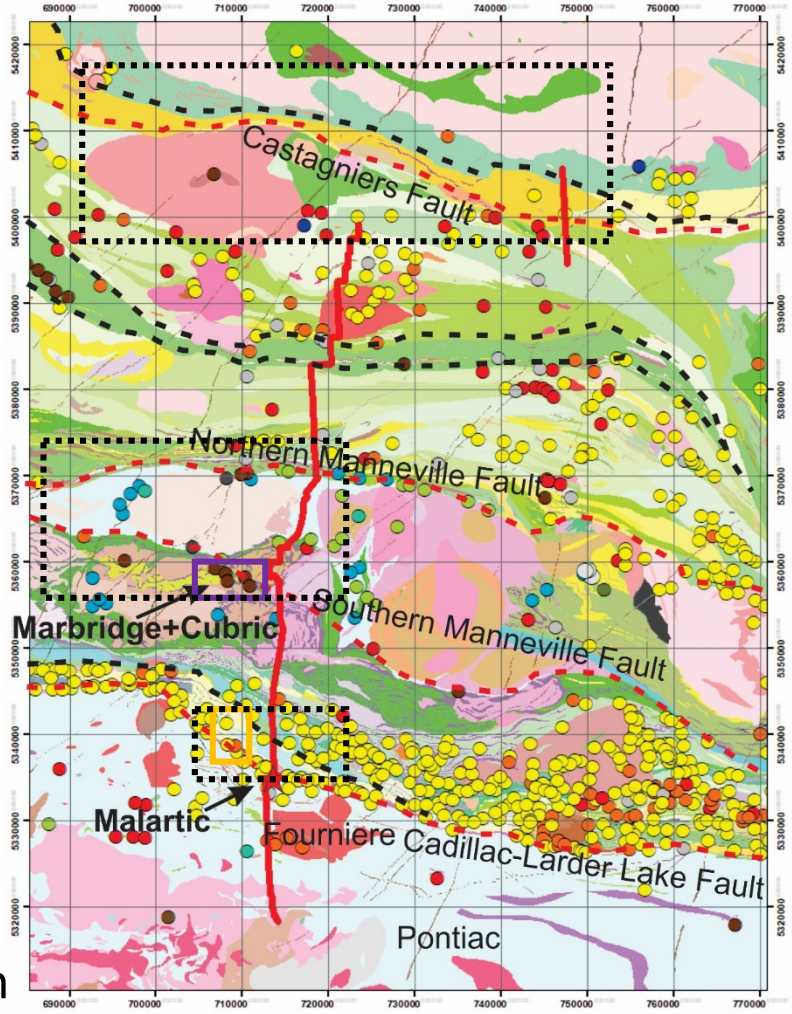


Major Research/Thesis Projects

- ✓ **Xiaohui Zhou, R.A.**
  1. Contact relationships and fault kinematics in major crustal-scale deformation zones
  2. Structural control and modification of mineral deposits
  3. Provenance, timing and tectonics of major sedimentary basins.

- ✓ **Brendon Samson, M.Sc. Student**
  Structural control on vein-type gold mineralization in the Cadillac basin

- ✓ **Danielle Shirriff, M.Sc. Student**
  Ore genesis and structural modification of Nickel Mineralization in Southern Manneville Fault.



(SIGEOM,2017)

Transect Mapping

Previous Work

Early GSC Mapping

- James & Mawdsley, 1927
- Gunning & Ambrose, 1940
- Tremblay, 1950
- Dawson, 1954
- Weber & Latulippe, 1964

MERN Quebec

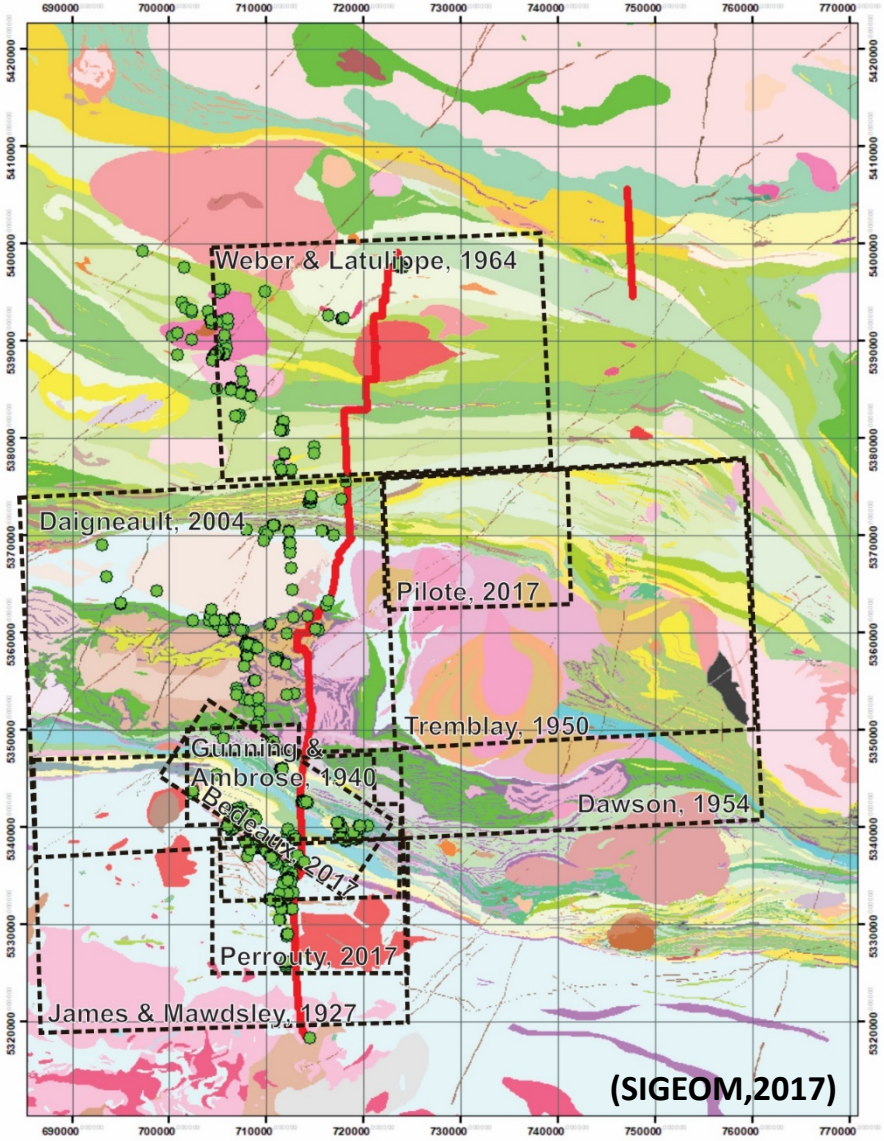
- Pilote, since 1993
- SIGEOM

Research Based on Recent Mapping

- Daigneault, 2004
- Perrouty, 2017
- Bedeaux, 2017

New data

- **Metal Earth Stations**

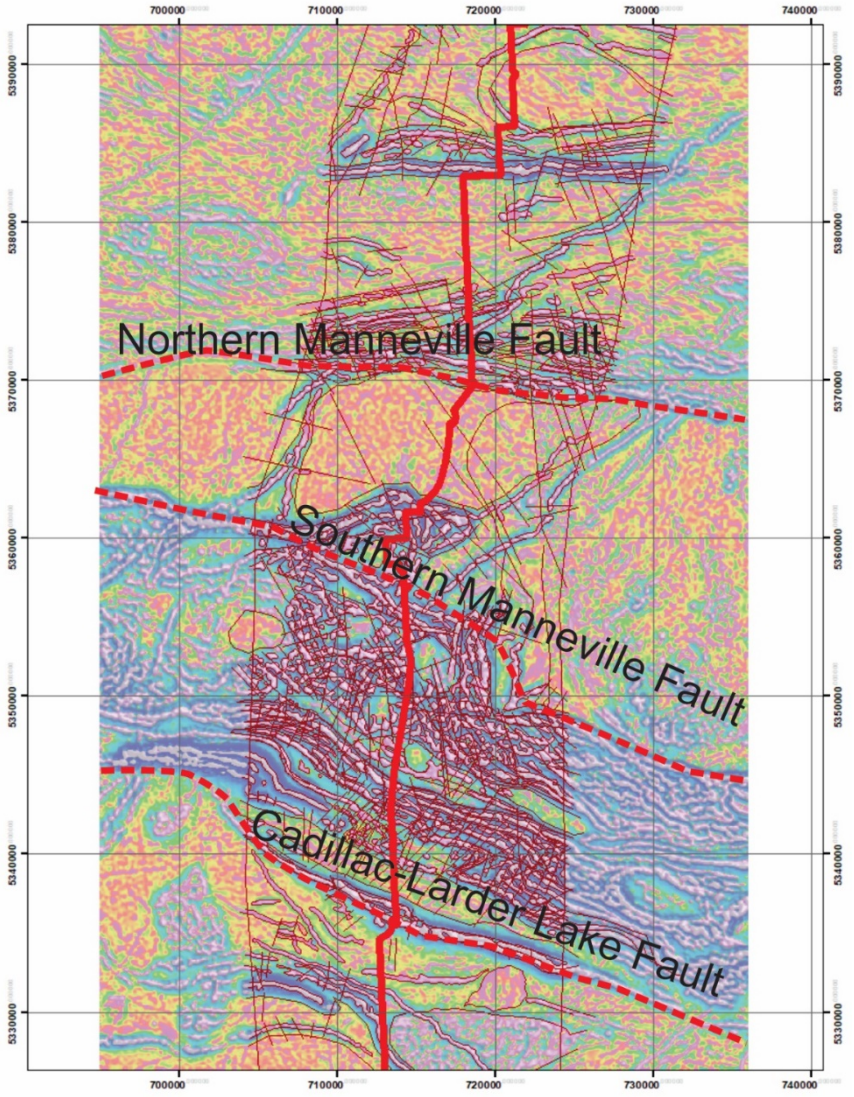


Aeromagnetic Interpretations

- **Tracing lithologic units**
  High Anomaly:
  Oxide Facies BIF, Ultramafic flow, Diabase dikes
  Moderate Anomaly:
  Felsic Plutons

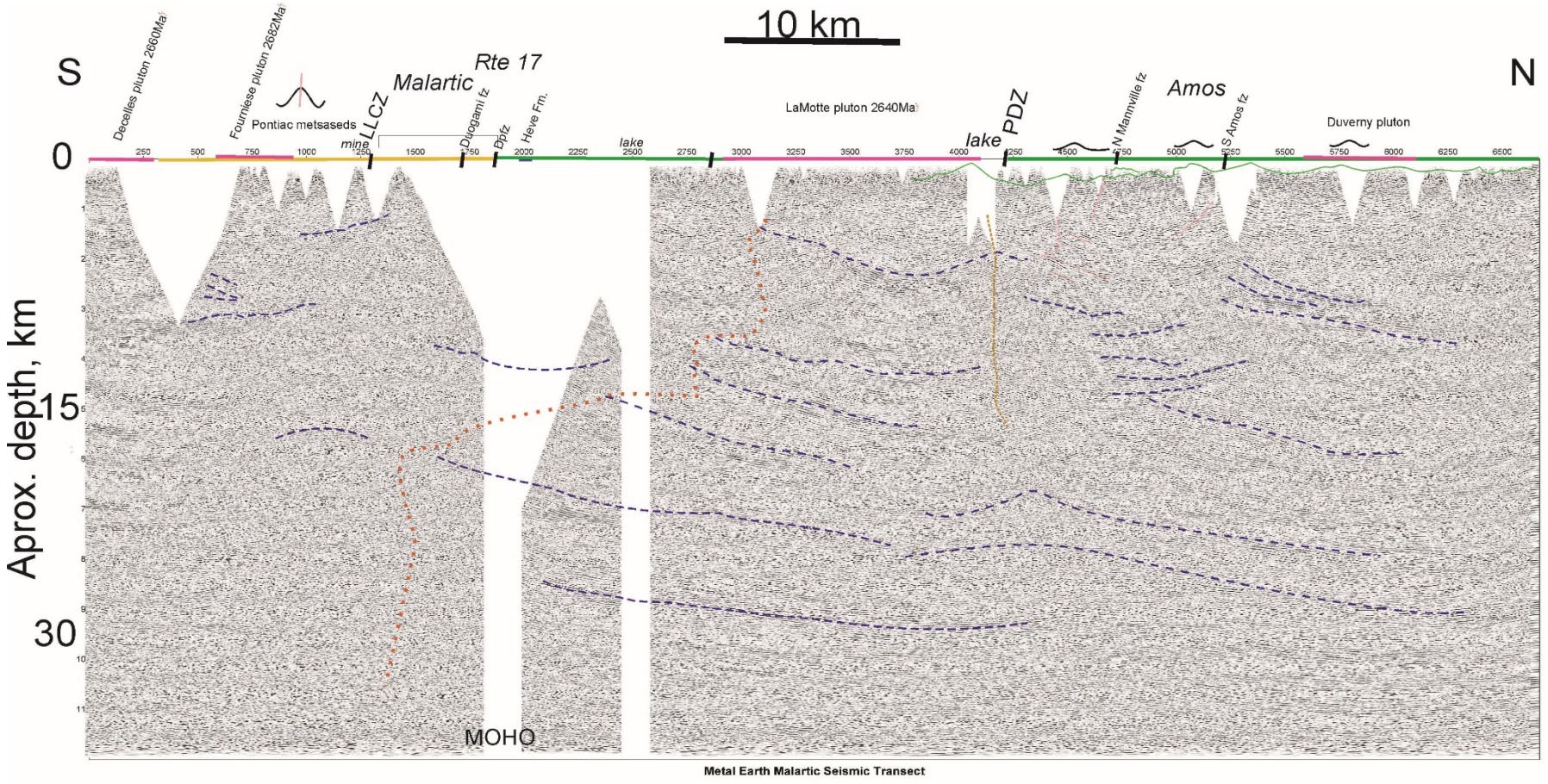
- **Structural Trend**

- **Fault interpretations**
  Discontinuities and offsets on the aeromagnetic map



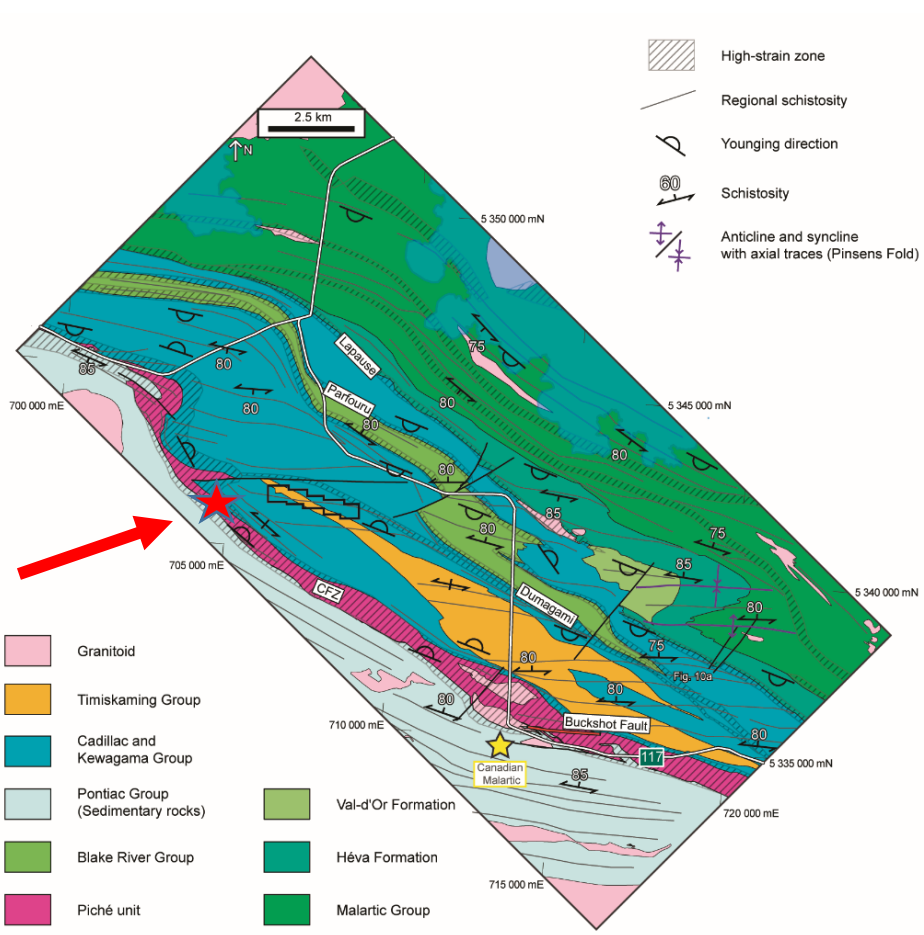
(Eshaghi, unpublished)

Seismic Interpretations

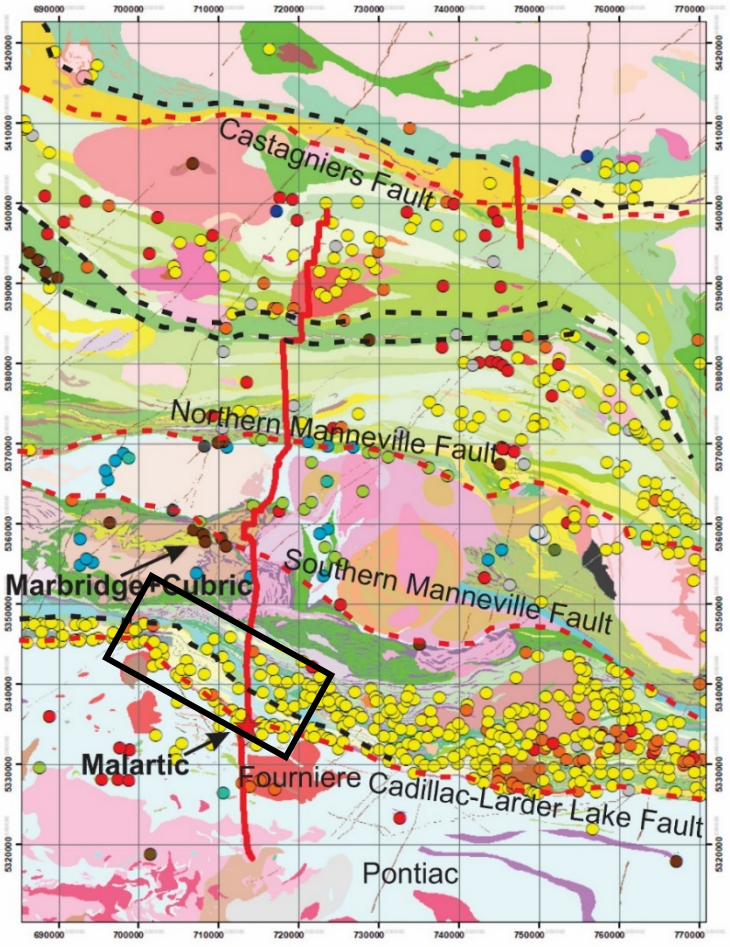


D. Snyder, pers. comm.

Larder Lake-Cadillac Break

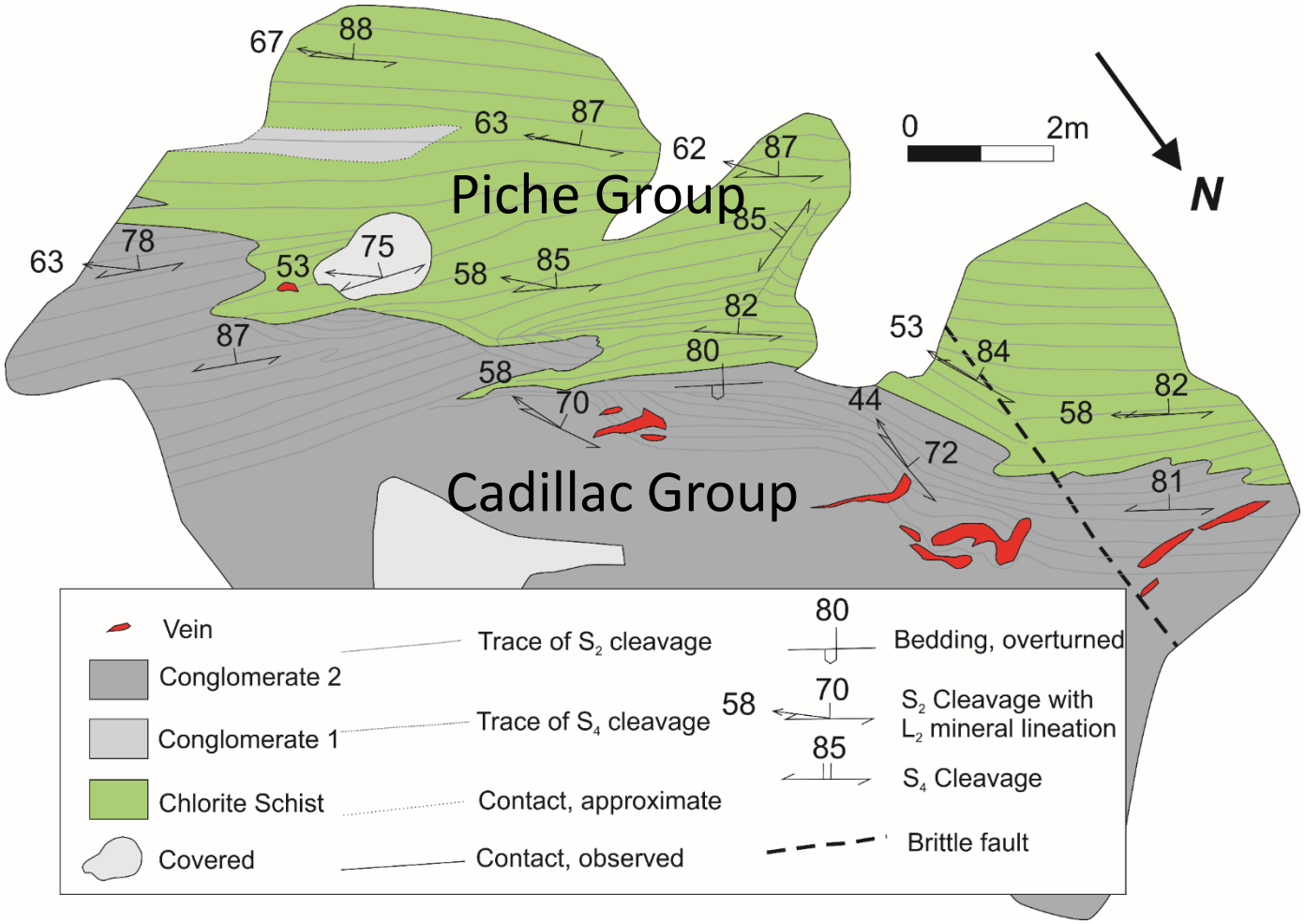


Bedeaux et al., 2017

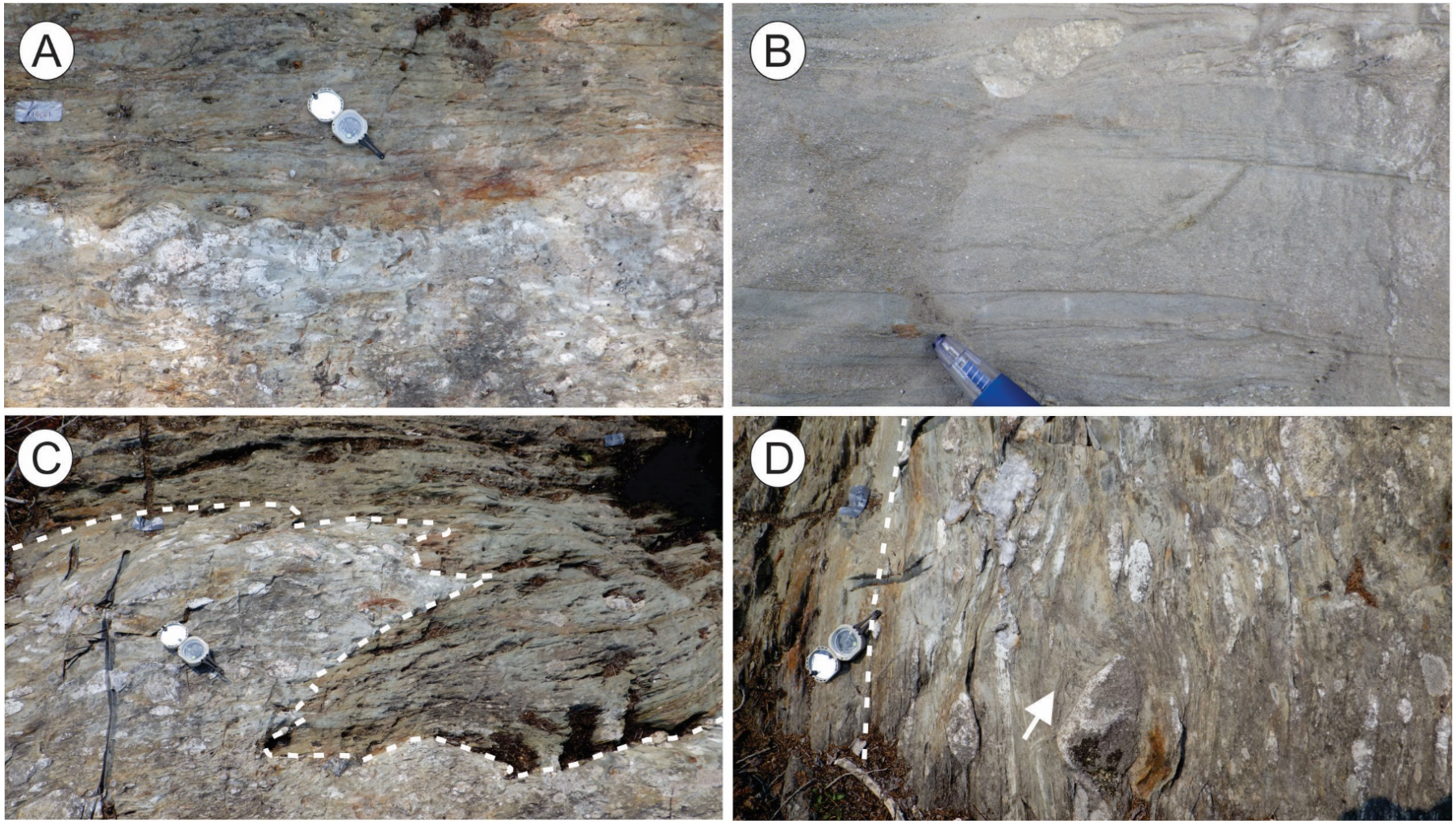


(SIGEOM,2017)

Larder Lake-Cadillac Break



Larder Lake-Cadillac Break



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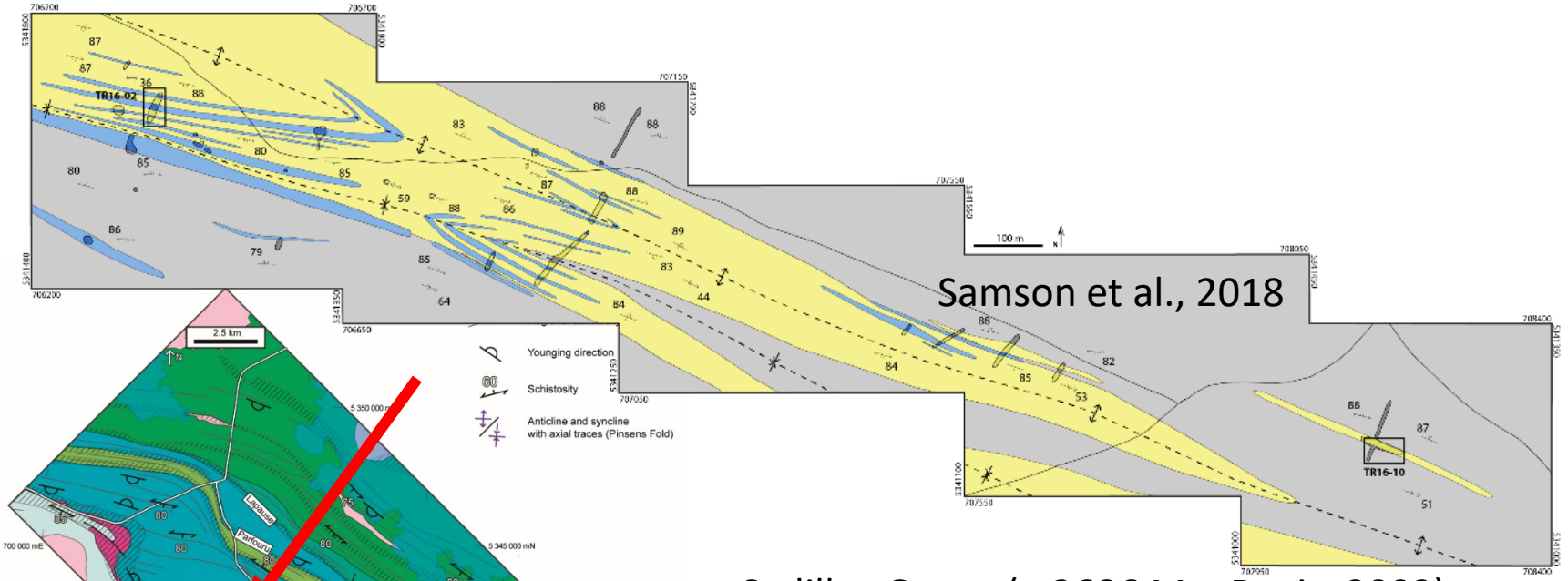
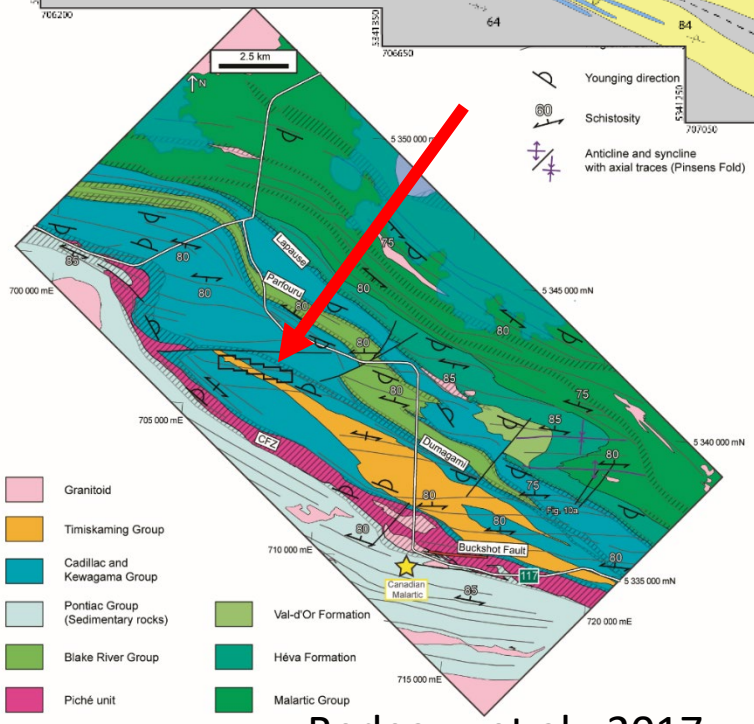


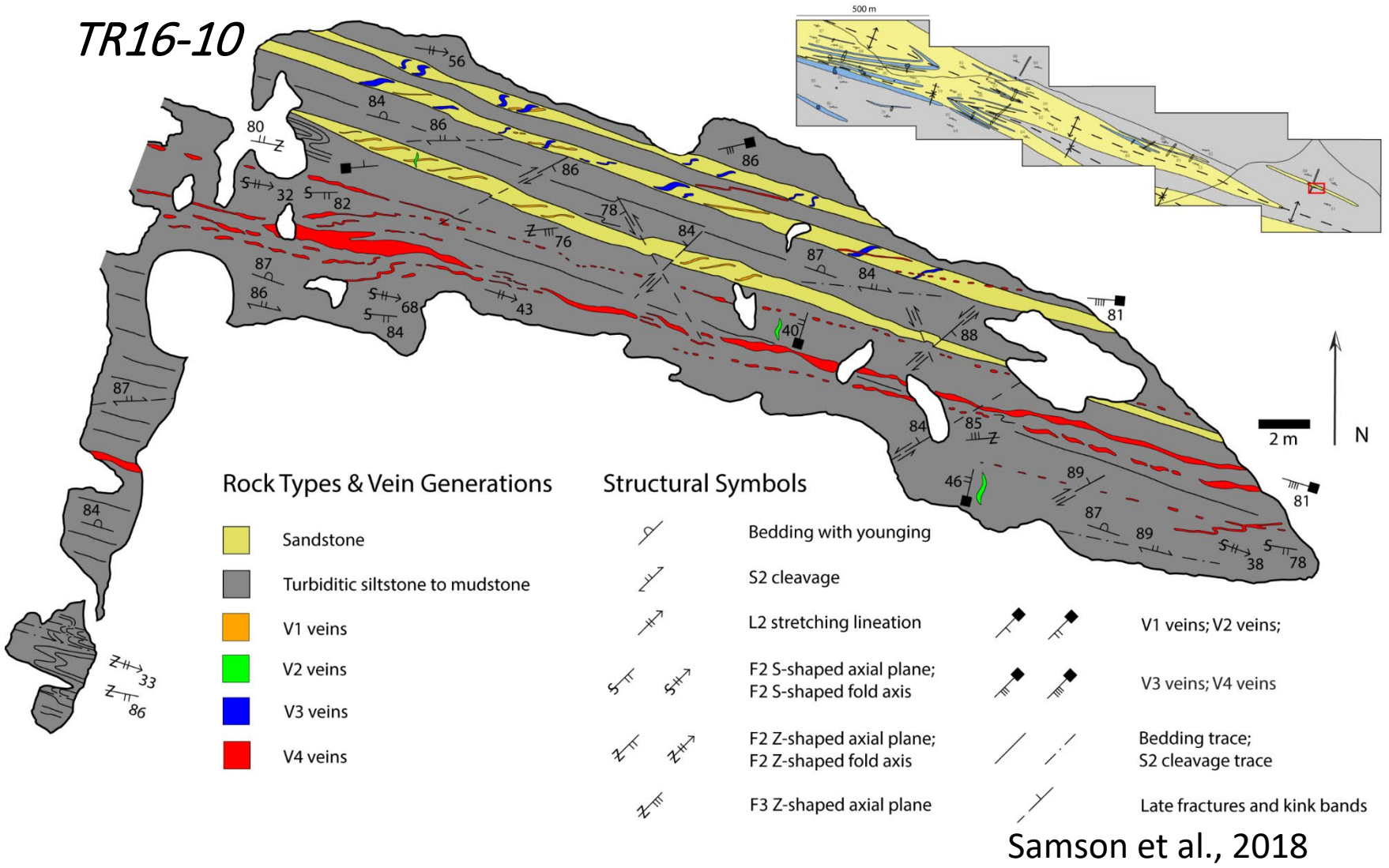
Samson et al., 2018



Bedeaux et al., 2017

- Cadillac Group (< 2686 Ma; Davis, 2002)
  - Turbidites and iron formations
- Timiskaming Group (2677 – 2672 Ma; Davis, 2002; Pilote et al., 2015a)
  - Fluvial conglomerate, sandstone, and shallow marine turbidites
- Greenschist facies metamorphism

Gold mineralization in the Cadillac Basin

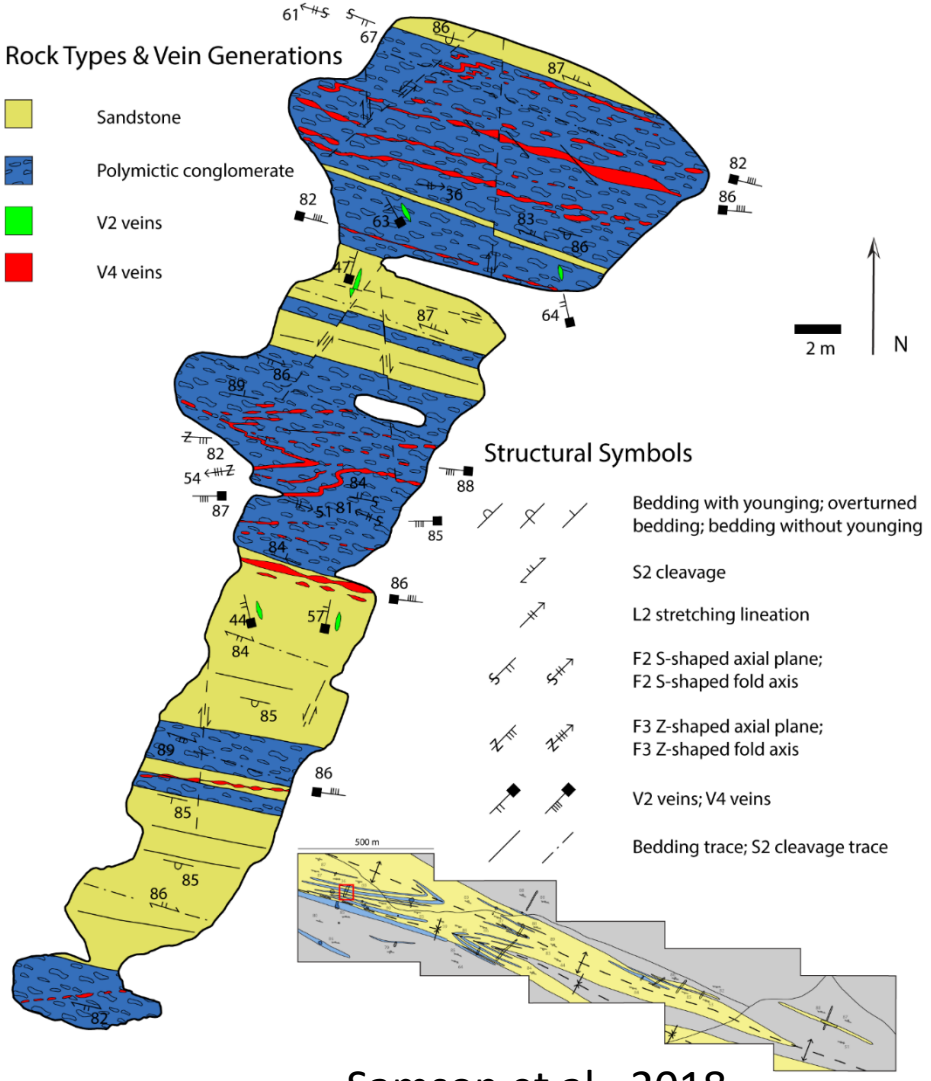


Samson et al., 2018

Gold mineralization in the Cadillac Basin

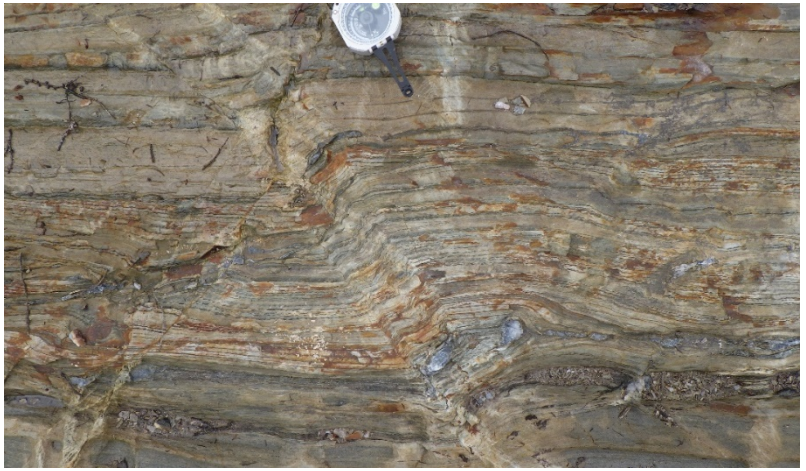
TR16-02

- **Located on southern limb of regional anticline**
- **Timiskaming-style conglomerate interlayered with massive and normal graded sandstone**
- **Cleavage is oriented clockwise to S-younging beds**
- **Gold-bearing veins are oriented anticlockwise to S-younging beds**

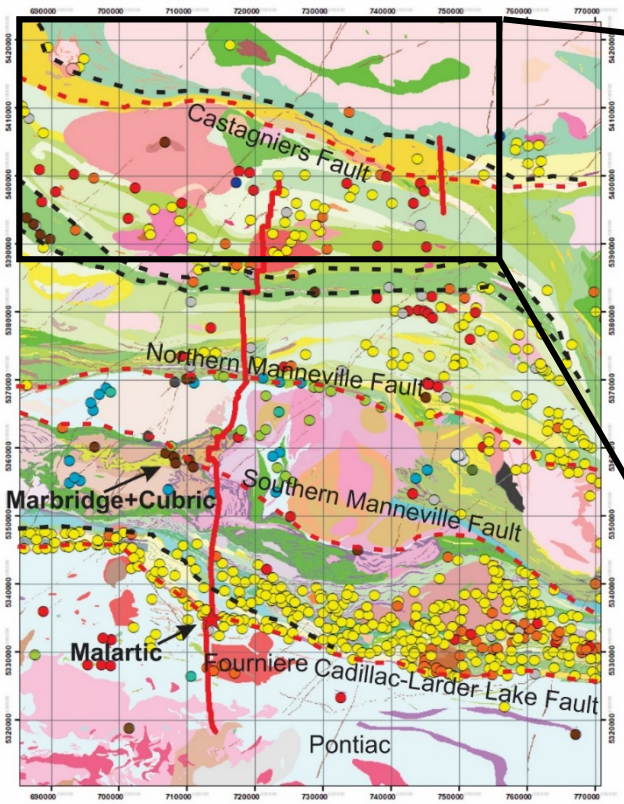


Samson et al., 2018

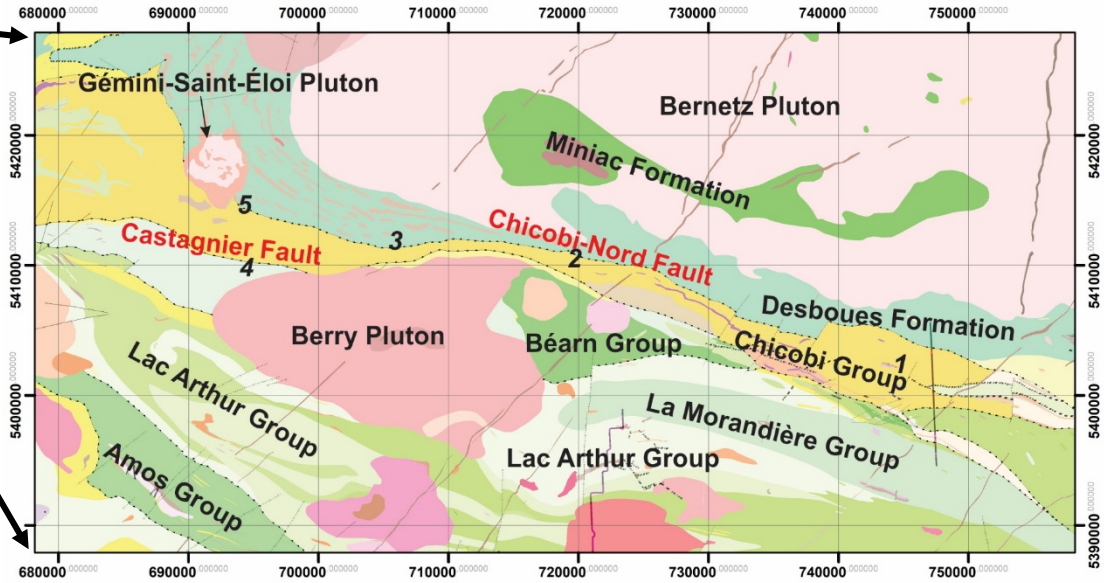
Deformation Structures and Veins in the Cadillac Basin



Chicobi Deformation Zone



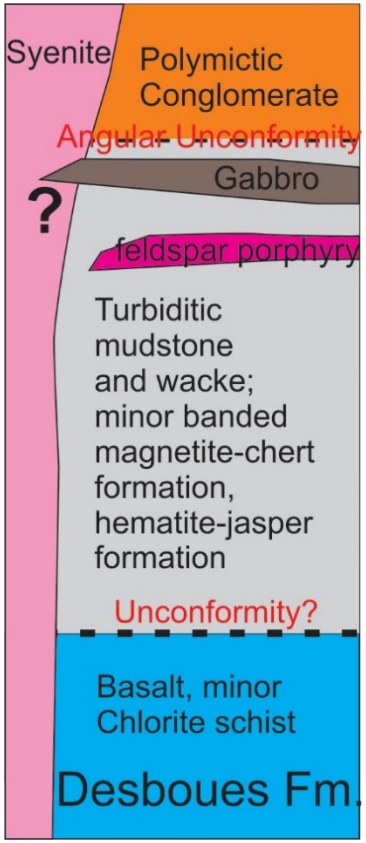
(SIGEOM,2017)

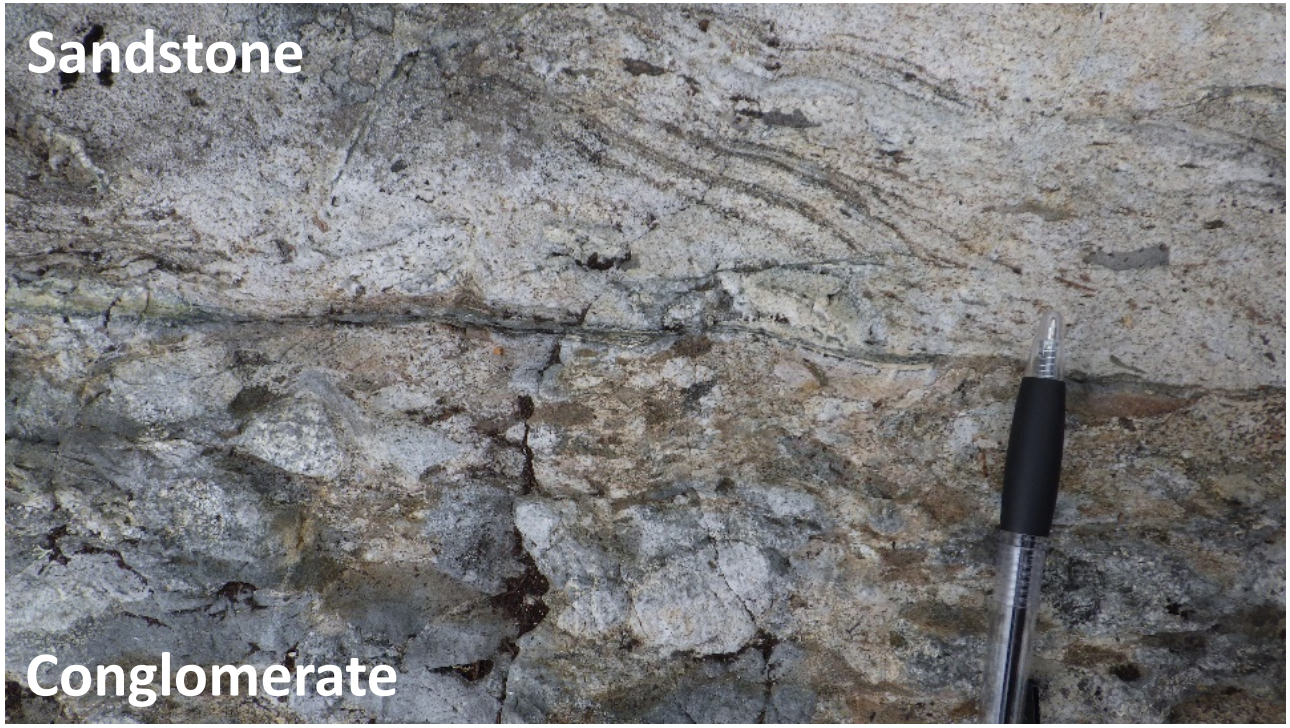


Chicobi Basin

- Turbiditic wacke and mudstone, BIF, crossbedded sandstone and polymictic conglomerate unconformably overlying older volcanic terranes
- Fault-bounded, multi-phase deformation
- Amphibolite facies metamorphism

Chicobi Deformation Zone





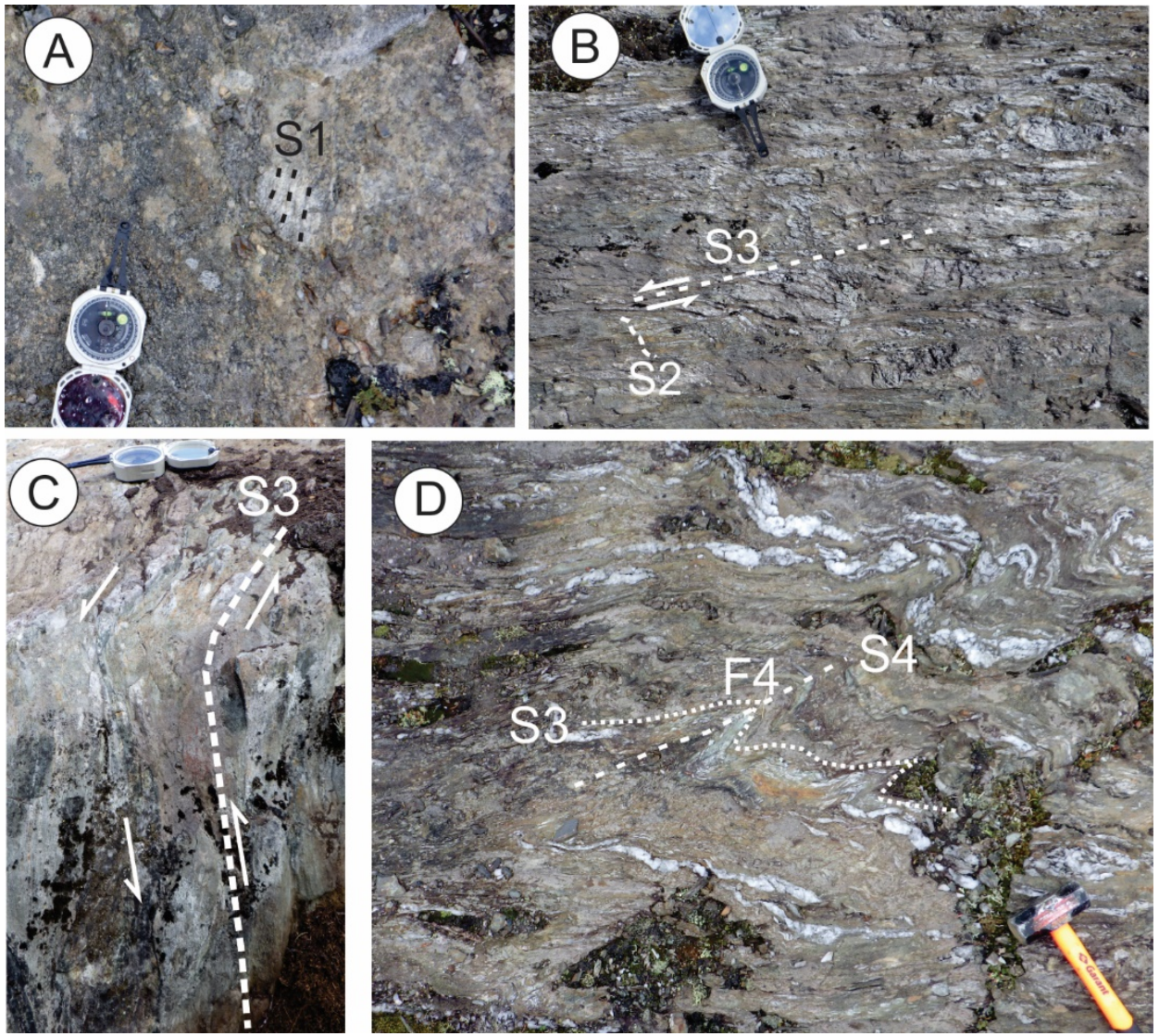
Angular unconformity between polymictic conglomerate and Underlying sandstone with a few mafic clasts.

Chicobi Deformation Zone

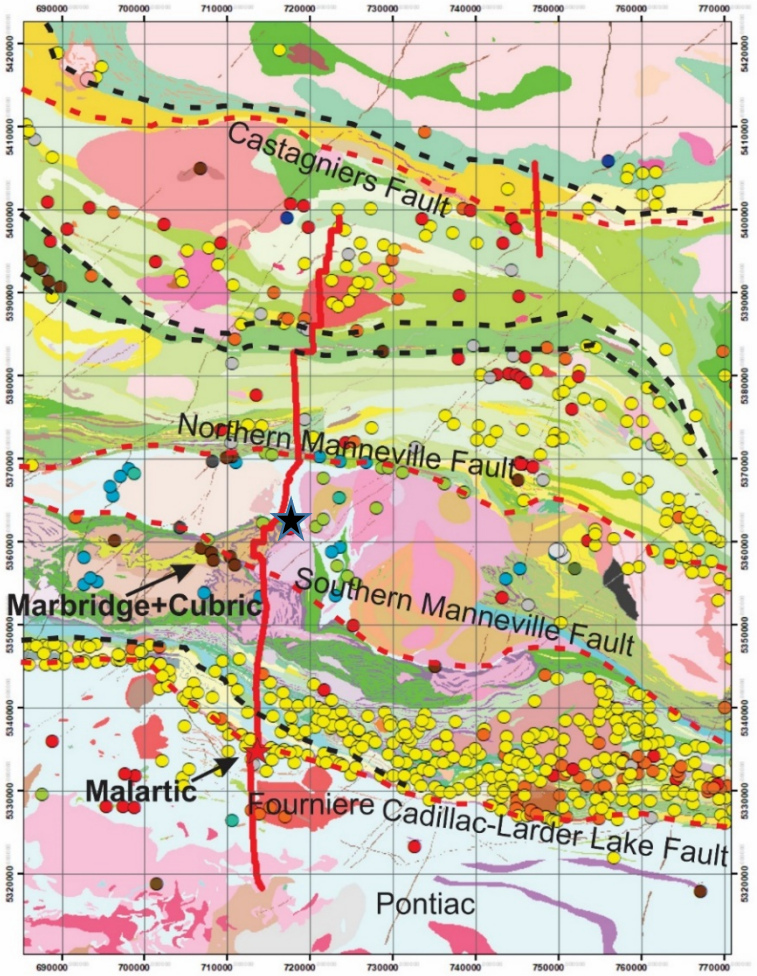
D1: isolated S1 fabrics in the clasts of Timiskaming type conglomerate
D2: penetrative NW-N striking S2 cleavage

D3: South-side-up sinistral shearing
W-striking subvertical S3 cleavage, steep stretching lineation

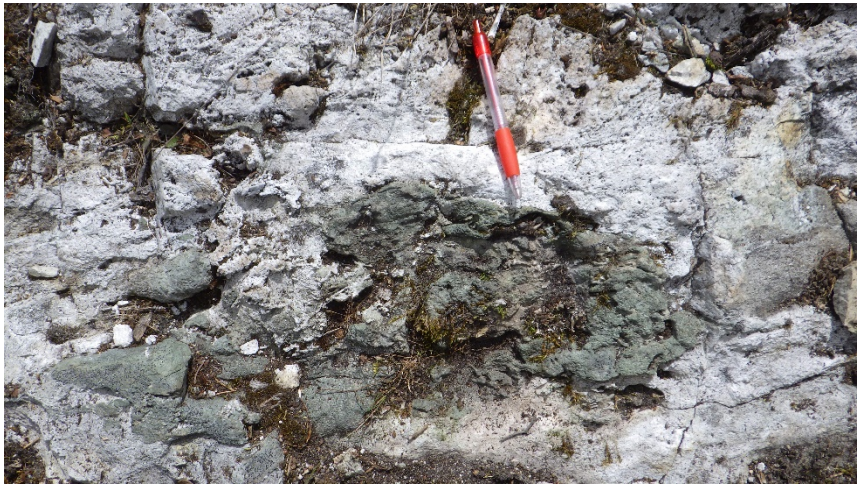
D4: Dextral shearing
Z drag folds



Porcupine-Destor-Manneville Fault



(SIGEOM,2017)



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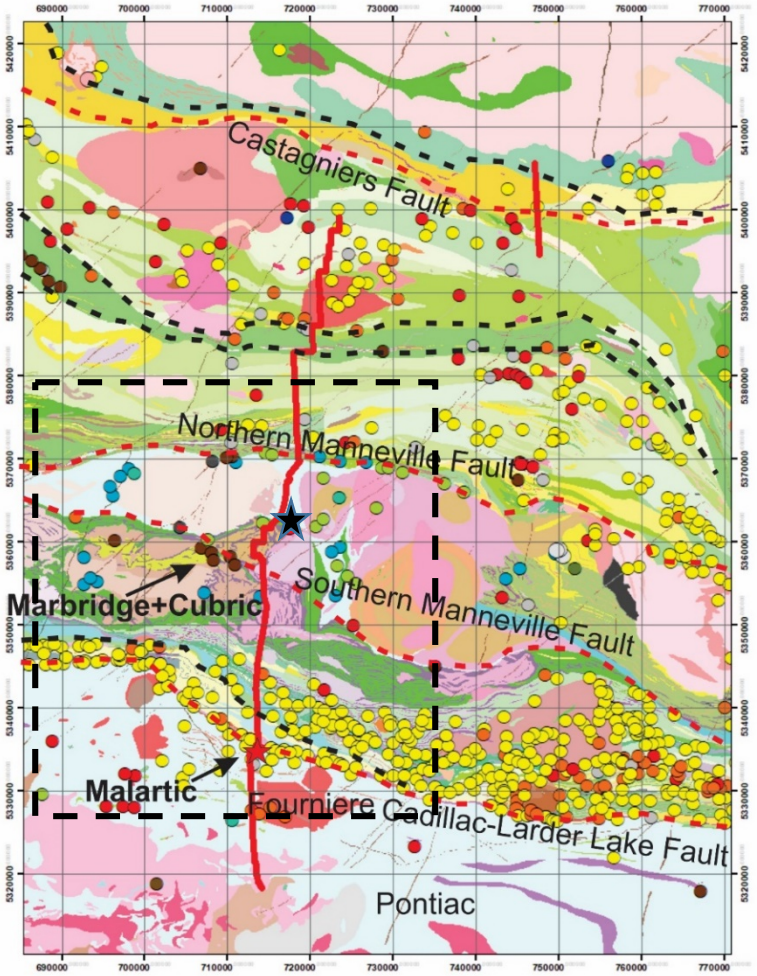

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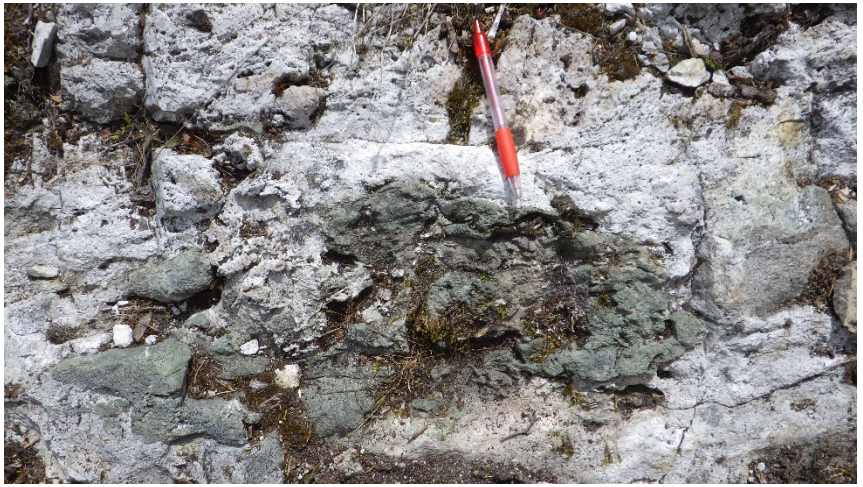
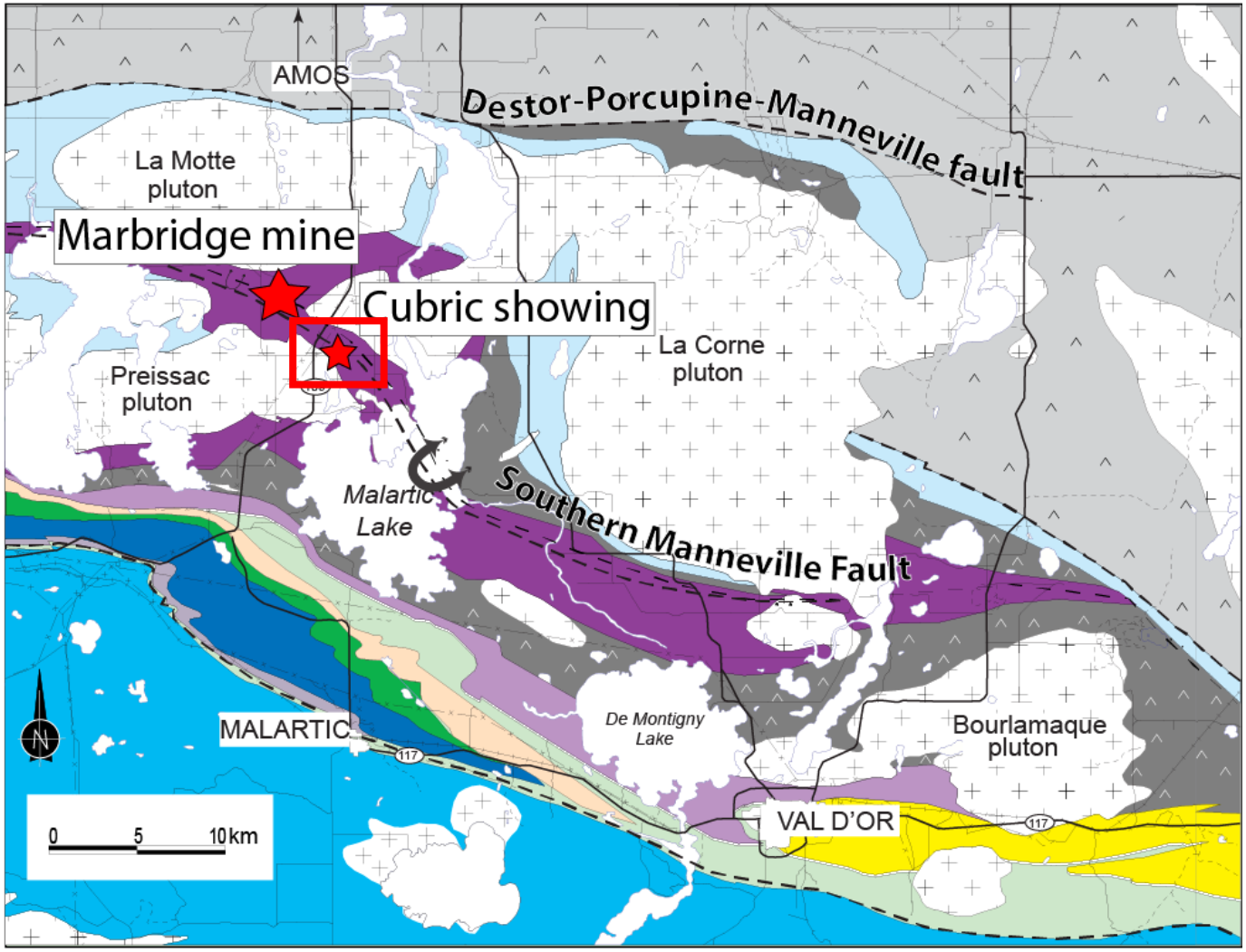


Porcupine-Destor-Manneville Fault



Intrusive rocks

Undifferenciated mafic volcanic rocks of the NVZ

Pontiac group: turbidites

BLAKE RIVER CALDERA COMPLEX (2705-2696 Ma):

Piche group: greywacke, conglomerate, minor volcaniclastic rocks; ultramafic slivers

Cadillac group:greywacke, argillite, conglomerate

Kewagama Formation: greywacke, conglomerate, minor volcaniclastic rocks

Blake river group: mafic and felsic flows, minor volcaniclastic rocks

La motte anticline

Deformation zones
Cadillac-Larder Lake Fault Zone (CLLFZ)
Destor-Porcupine-Manneville Fault Zone (DPMFZ)

MALARTIC BLOCK (2714-2702 Ma):

Heva formation: basalt flows and breccias, minor volcaniclastic rocks

Val d'Or formation: andesitic volcaniclastic rocks, basalt flows and breccias

Jacola formation: basalt flows and breccias, minor komatiites

Dubuisson formation: basalts, minor komatiites

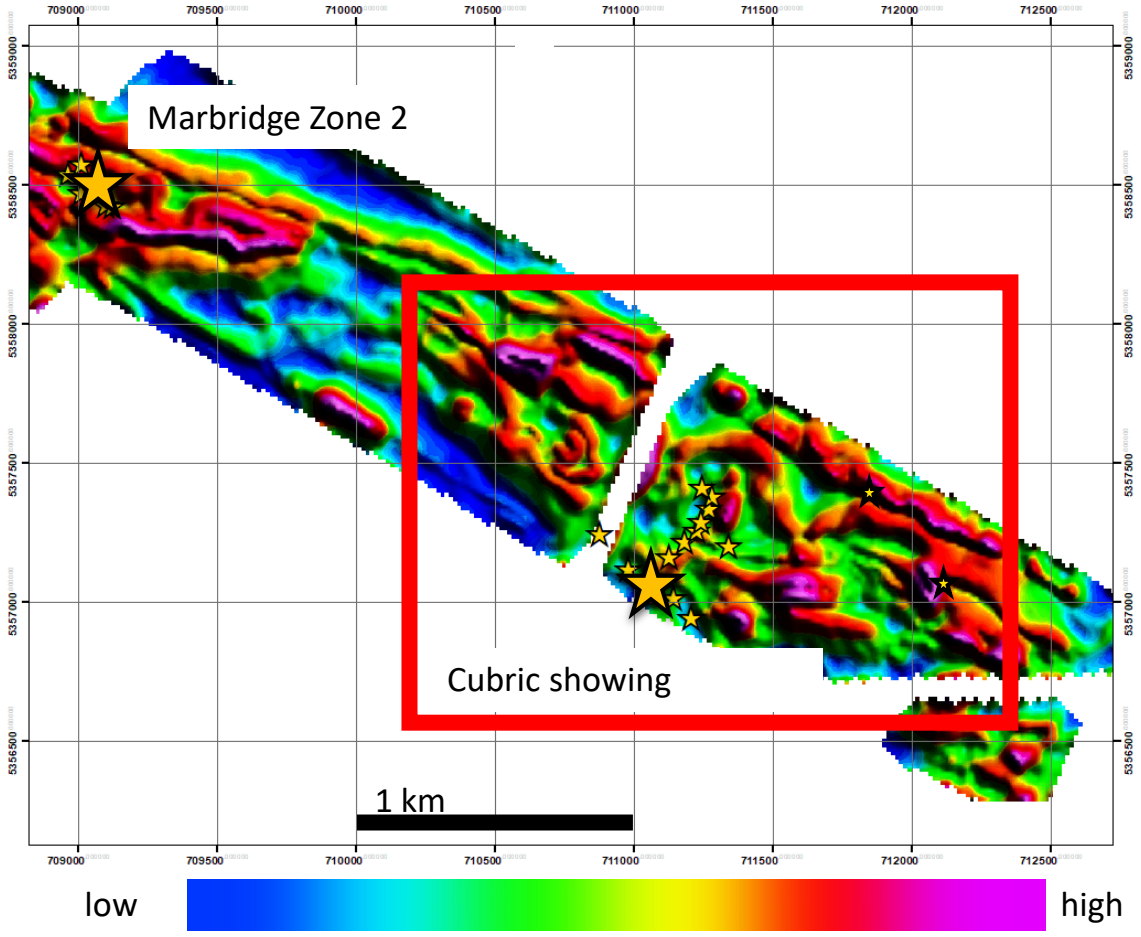
Caste formation: turbidites

La Motte-Vassan formation: komatiites, minor basalts, volcaniclastic rocks

Shirriff et al., 2018, modified from Mueller et al., 2008

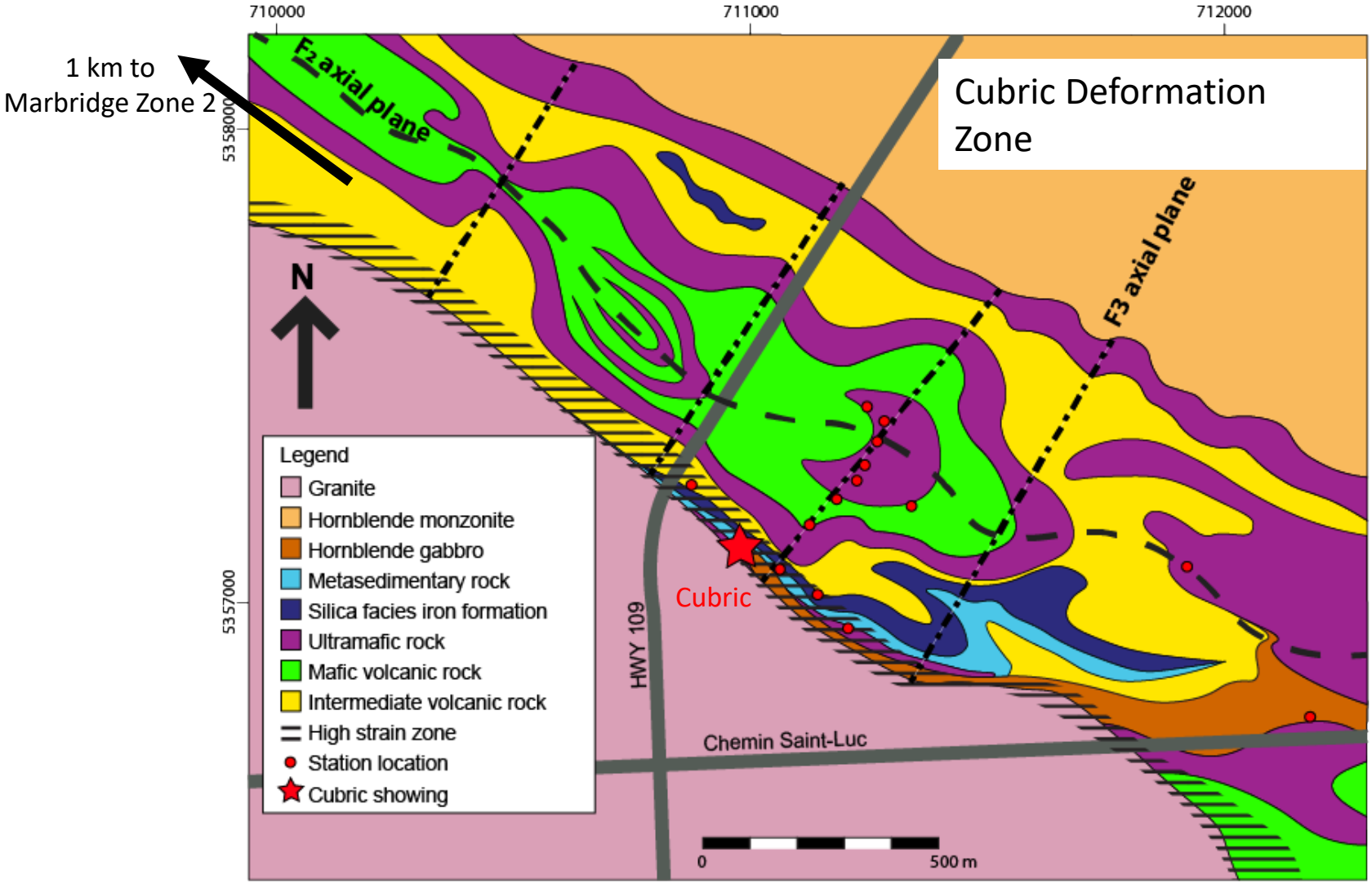
Southern Manneville Fault Zone

- Bedrock mapping of the surrounding area
  - Diamond drill core logging
  - Grid mapping
- Magnetics survey



Shirriff et al., 2018

Southern Manneville Fault Zone



Shirriff et al., 2018

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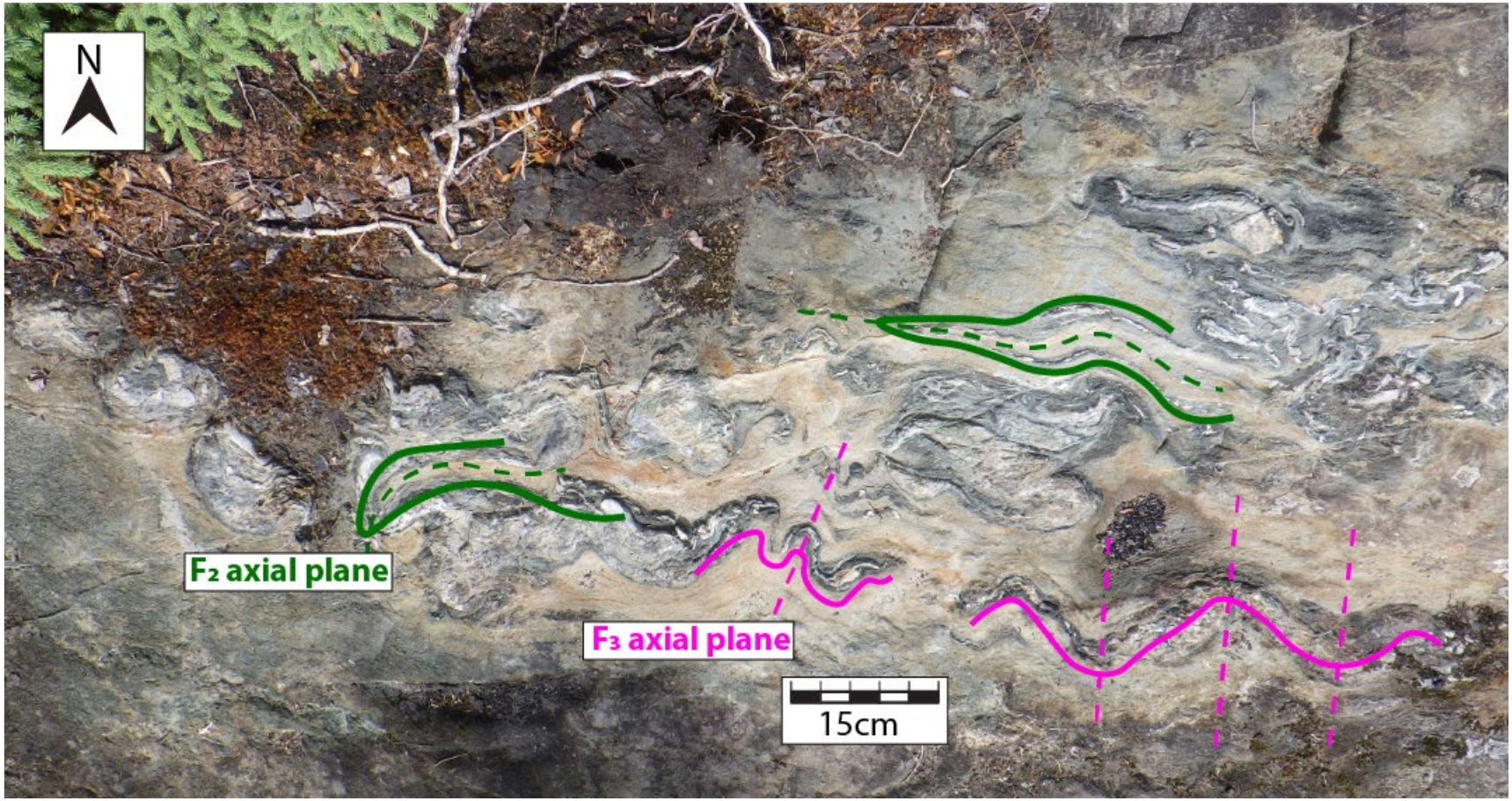
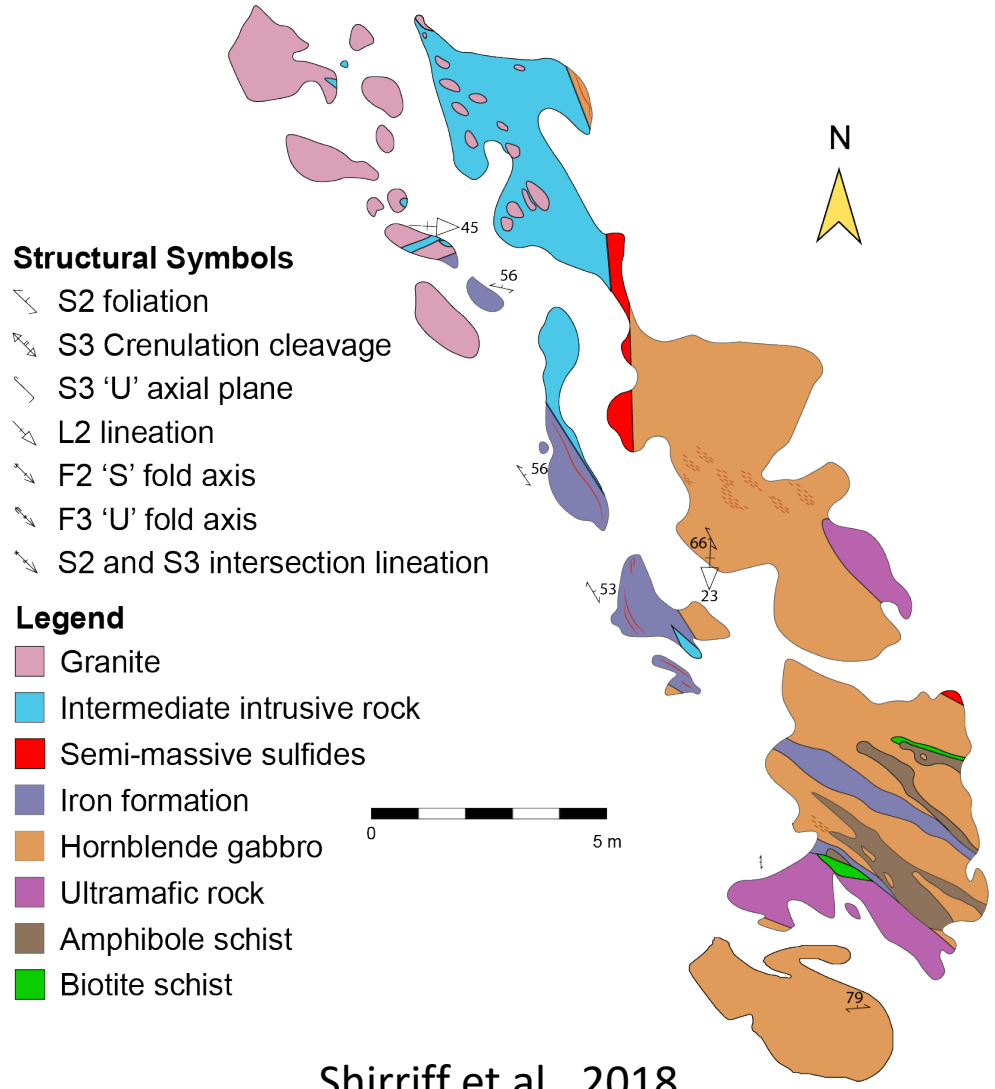


Shirriff et al., 2018

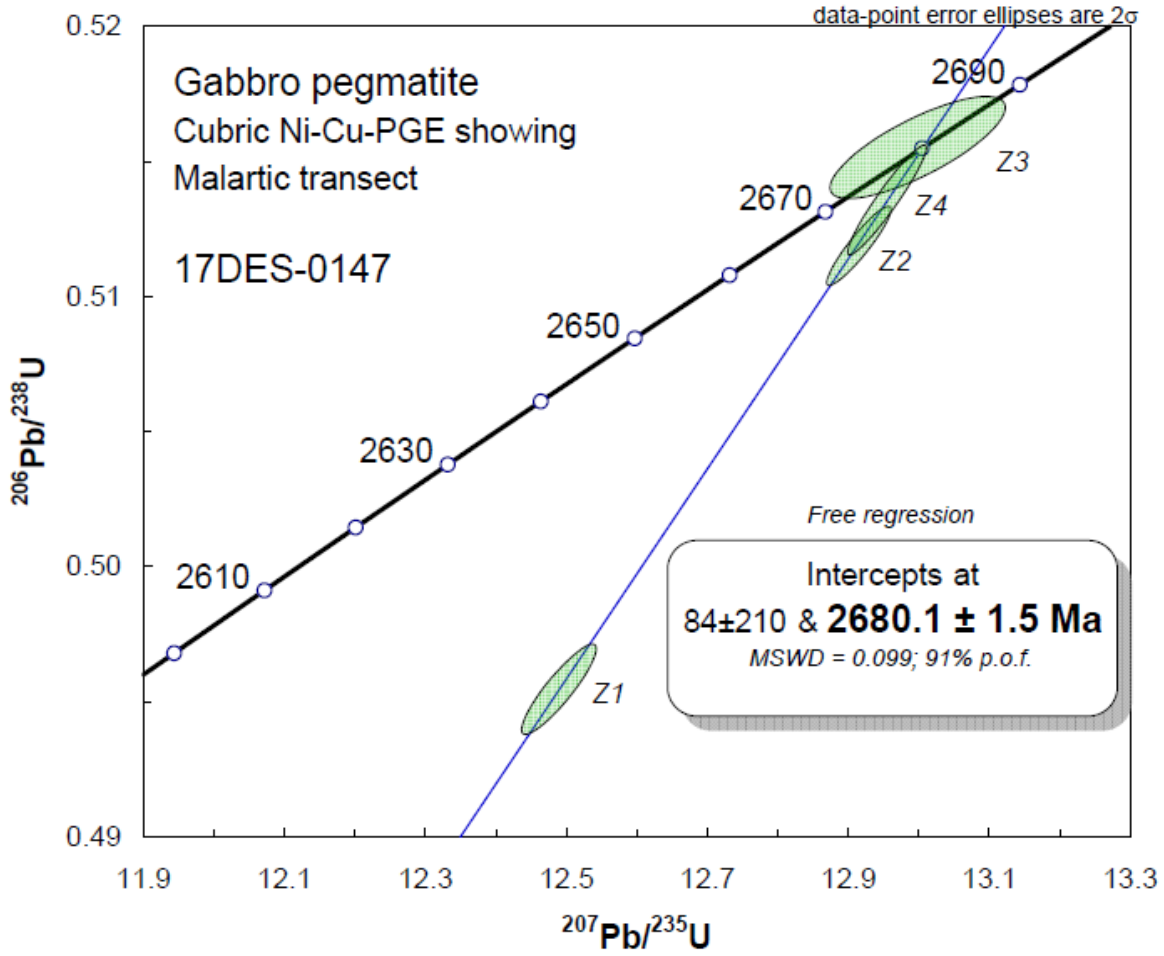
Cubric Showing

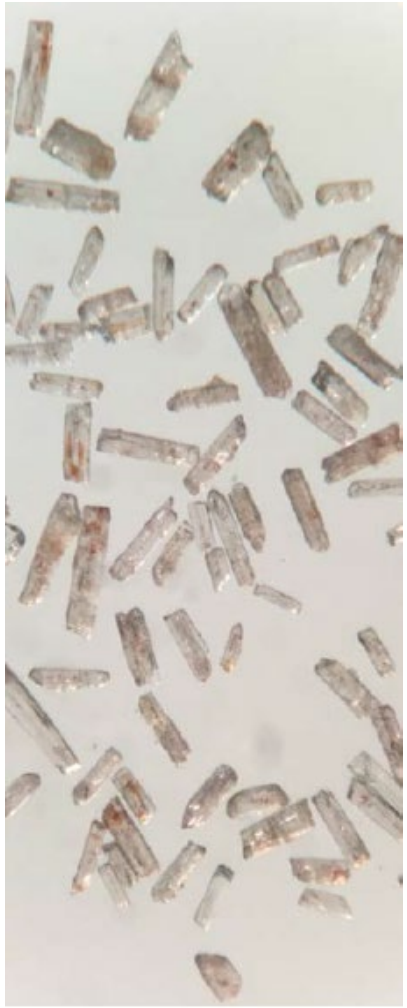
- 2.5% Ni, 0.2% Cu, 0.5 ppm Pt+Pd
- Mineral assemblage: pyrite – pyrrhotite – magnetite -chalcopyrite ± pentlandite ± violarite
- Mineralization occurs in silicate facies iron formation and hornblende gabbro



Shirriff et al., 2018

Cubric Showing





M. Hamilton, pers. comm.

Cubric Nickel Showing

Tectonic mobilization of magmatic sulfides:

- High Ni/Cu ratios consistent with komatiite origin - identical to Marbridge
- Ultramafic rocks are proximal to mineralisation

Metamorphic-hydrothermal deposition:

- Pyrite accounts for 80-90% of total sulfides
- Pyrite does not typically form through magmatic processes
- Iron formation commonly hosts hydrothermal mineralization

Shirriff et al., 2018

Conclusions

- Contacts between older volcanic terranes and younger sedimentary basins were originally unconformities, and then overprinted by regional folds and penetrative cleavage.
- Gold-bearing veins in the Cadillac basin near the Larder Lake-Cadillac break formed during sinistral shearing that postdates regional folding, and then overprinted by late dextral shearing.
- Nickel ore bodies at Cubric showing were structurally remobilized during regional folding (< 2680 Ma) from nearby ultramafic flows or BIF.
- New geological mapping results will help interpret Metal Earth seismic and MT data. These geophysical and geological data will assist in identifying mid-crustal structures, potentially distinguishing well endowed terranes such as Abitibi from less endowed areas.

Acknowledgments

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